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Overview

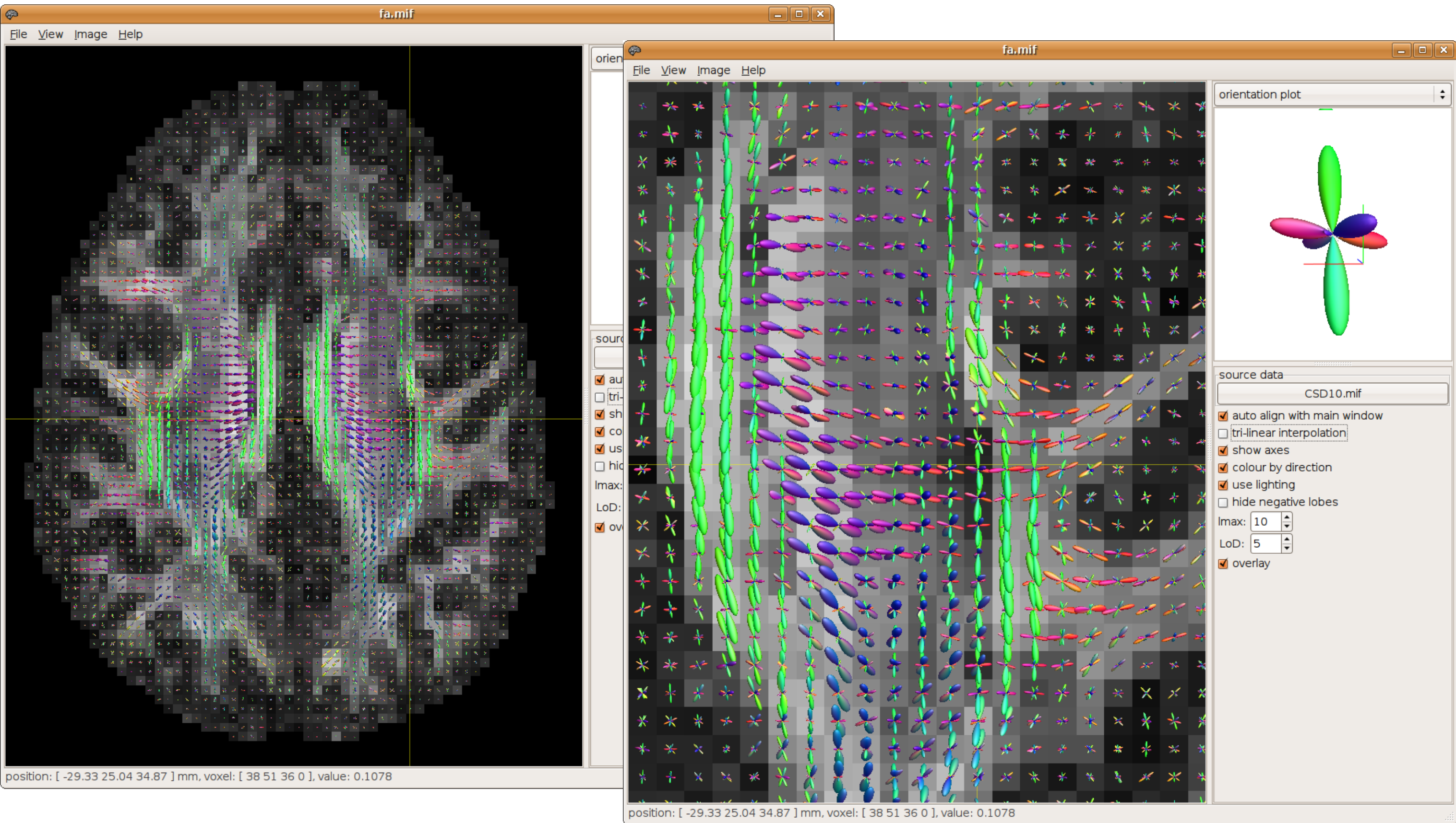
MRtrix is a software package to perform probabilistic DWI white matter tractography using fibre orientations obtained using constrained spherical deconvolution (CSD) to account for crossing fibres.

Features

- Both deterministic & probabilistic streamlines algorithms available
- Efficient & robust CSD implementation
- Can also be used for tensor-based analysis
- Can be used to generate 'connectivity maps'
- Tracks can be exported as text for further analysis
- Supports DICOM, NIfTI & Analyse formats
- Command-line interface allows for scripting
- Includes OpenGL-based viewer
- Written in C++ for efficiency
- Multi-threaded for multi-core systems
- Runs on most recent GNU/Linux distributions

Constrained spherical deconvolution (CSD)

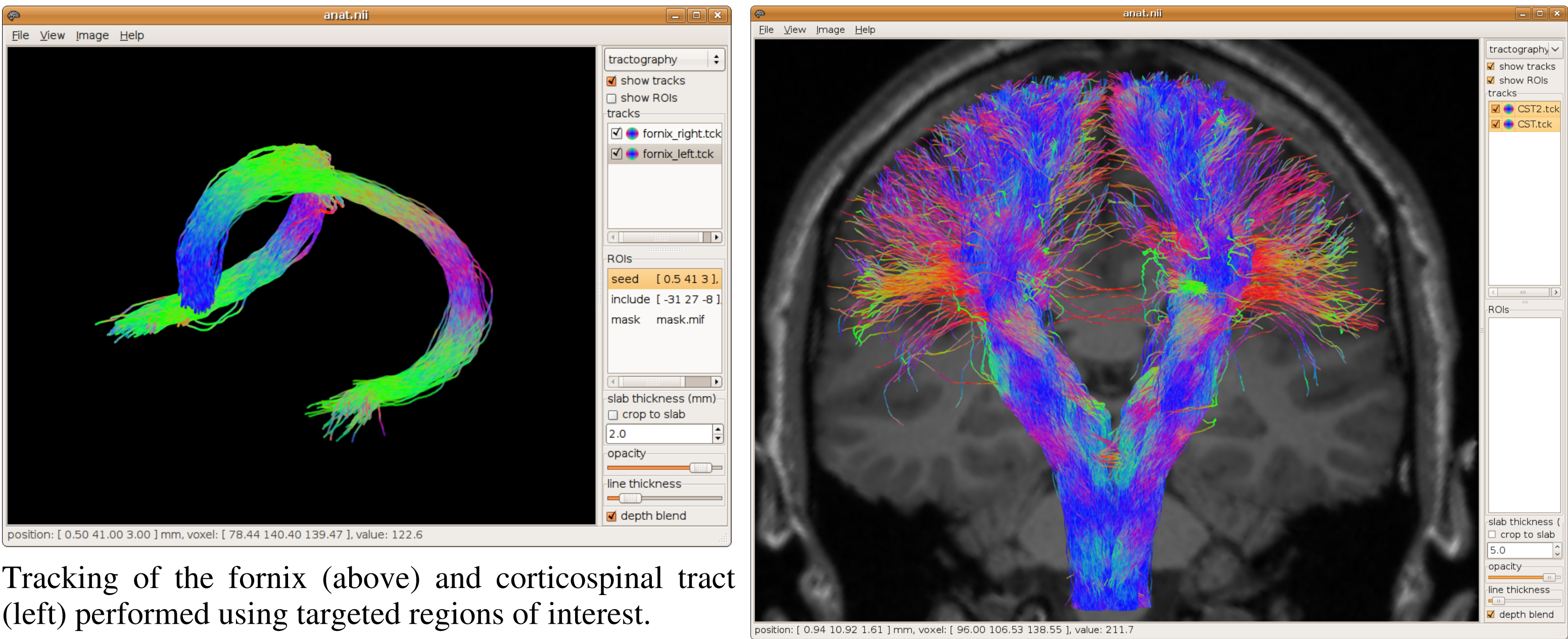
MRtrix uses constrained spherical deconvolution (CSD) [1] to obtain the fibre orientation distribution (FOD) within each voxel. These FOD can be displayed and overlaid on images such as the FA map below.



Fibre orientation distributions (FOD) obtained using CSD within each voxel, overlaid on the corresponding axial FA map. Left: whole brain; right: close up of left centrum semiovale. The FOD within the voxel in the crosshairs is displayed in the sidebar. Each FOD is coloured according to direction (red: left-right; green: anterior-posterior; blue: inferior-superior).

Targeted fibre-tracking

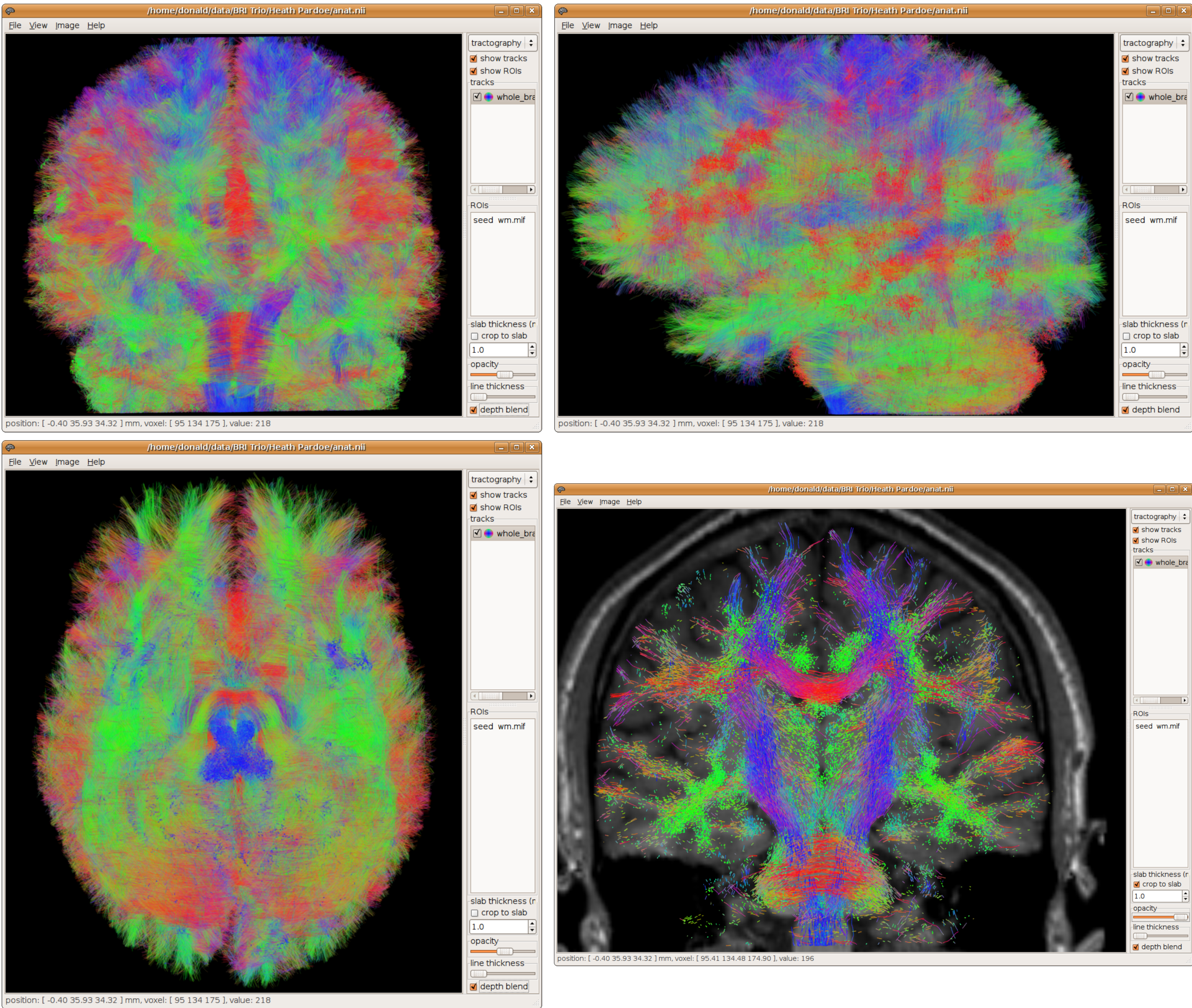
MRtrix can be used to perform targeted fibre-tracking, by selecting seed, inclusion or exclusion regions of interest. These can be specified as spherical regions, or binary mask images.



Tracking of the fornix (above) and corticospinal tract (left) performed using targeted regions of interest.

Whole-brain probabilistic fibre-tracking

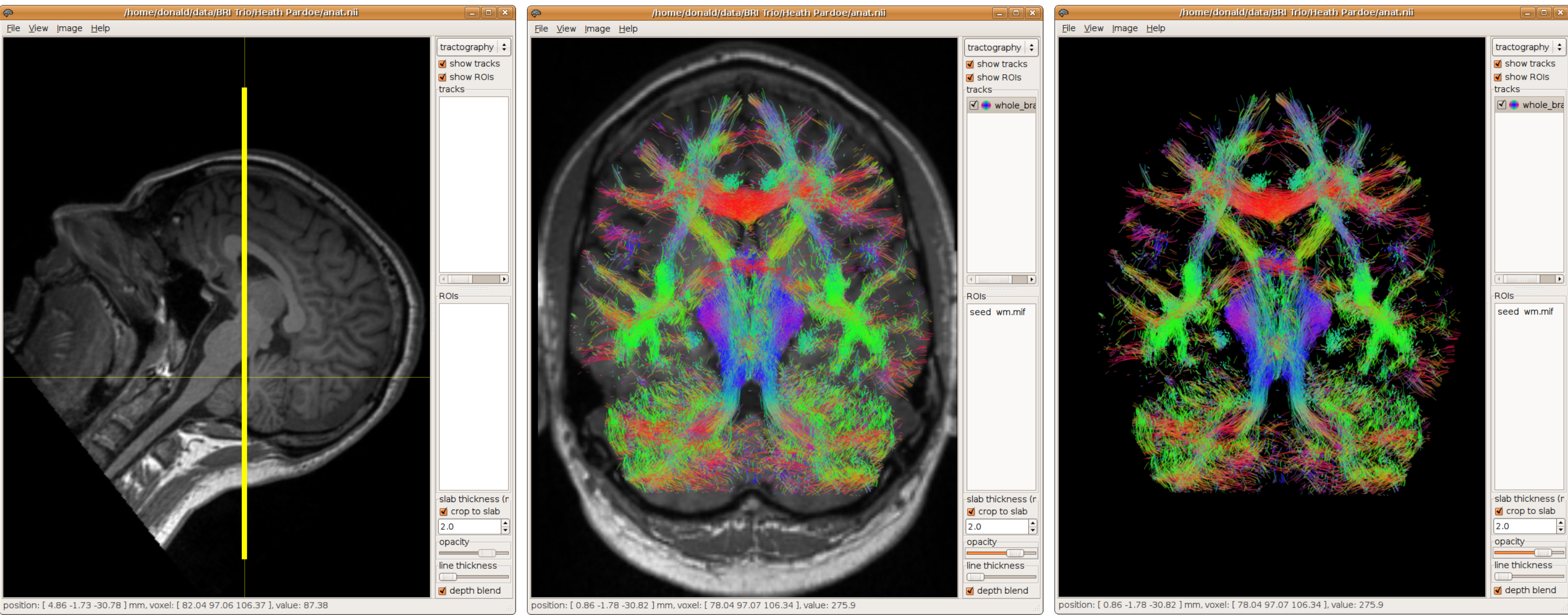
MRtrix can be used to generated whole-brain tractograms, using the probabilistic streamlines [2] algorithm coupled with the fibre orientations produced using CSD.



100,000 probabilistic streamlines seeded from within a white matter mask, viewed as coronal, sagittal and axial projections respectively. Bottom right: the same tracks overlaid on the corresponding coronal T1-weighted image; only those portions of the tracks that lie within a 1 mm slab around the slice of interest are displayed.

Tilted slice display

Tractography results can be overlaid on any co-registered image, at any desired angle. This allows fibre tracts to be displayed within the plane of the fibres for improved visualisation.



Tractography results overlaid on an angled T1-weighted image. Left: a sagittal projection of the T₁-weighted image, showing the angle of the slice of interest. Middle: whole-brain tractography results overlaid on the angled slice of interest. Right: the same results with the background T₁-weighted image removed.

References

- [1] Tournier et al., NeuroImage 35: 1459-1472 (2007).
- [2] Behrens et al., Magn. Reson. Med. 50: 1077-1088 (2003).